11 March 1992 Final Student Research Report

Communications: The Critical Component of MTACCS

Captain R. H. Taplin, USMC, Captain L. R. Marshall, USMC; Captain P. A. Miller, USMC; Captain R. W. Housewright, USA; Captain D. Philpot, USMC

Command and Control Systems Course
Communication Officer's School
2085 Morrell Avenue
Quantico, Virginia 22134-5058

Marine Corps University
Marine Corps Combat Development Command
2076 South Street
Quantico, Virginia 22134-5068

Thesis: The current United States Marine Corps Tactical Communication Architecture (MCTCA) will not support the proposed component systems of the Marine Tactical Command and Control System (MTACCS). This paper explores the concept of automating command and control systems by making use of the technology explosion to support the warfighter.

USMC; Command and Control; C2; C3; C4I; Joint Command and Control; FDS; GMF; LAN; MIFASS; MTACCS; MNS; TCO; Aquisisiton; Development 25

Unclassified Unclassified Unclassified

COMMUNICATIONS: THE CRITICAL COMPONENT OF MTACCS

Submitted to
Major Cocks
and Mrs. Cundick
at the Communication Officers School
Quantico, Virginia

Captain R. H. Taplin, USMC
Captain L. R. Marshall, USMC, (Editor)
Captain P. A. Miller, USMC
Captain R. W. Housewright, USA
Captain D. Philpot, USMC

11 March 1992

COMMUNICATIONS: THE CRITICAL COMPONENT OF MTACCS

Outline

Thesis: The current Marine Corps Tactical Communications Architecture will not support the proposed component systems of the Marine Tactical Command and Control System.

I. Introduction

II. Scope of Research

III. MTACCS

IV. Tactical Communications Architecture

- A. Single Channel Radios
- B. Switched Backbone

V. Marine Corps Acquisition and Development Process

VI. Analysis

VII. Recommendations

VIII. Conclusion

Summary of Acronyms

Bibliography

COMMUNICATIONS: THE CRITICAL COMPONENT OF MTACCS

The problem of commanding and controlling armed forces, and of instituting effective communications within them, is as old as war itself. A Stone Age chieftain had to devise the optimal organization and find the methods and technical means to command the forces at his disposal. From his day to ours, failure to consider and to solve this problem has been to court disaster--indeed, to make it impossible for the forces to exist. (23:1) The core of an effective command and control (C2) system is the ability to collect, process, display, store, and forward essential information for the commander in a timely manner so he can influence the battle. (17:xiv)

Information control is perhaps the most crucial element. The problem of information management and control now includes the handling of volumes of information readily available. It is ironic that current military information and intelligence collection systems provide an over abundance of data to a commander who once suffered from a lack of information. Excessive information creates two important problems for the commander to solve: the capability of the human brain to assimilate that which is necessary and that which is not, and an overload of communication systems that chokes the military's ability to function effectively. A balance is necessary to ensure that operational dialogue between commanders takes place. (11:32-35) Current thinking is to fuse this information into an acceptable form for C2 purposes. Staff research and development (R&D) in this area is continuing with the development and fielding of the Marine Tactical

Command and Control System (MTACCS). However, the concurrent development of tactical communication equipment to support the MTACCS concept is lagging behind. The current Marine Corps Tactical Communications Architecture (MCTCA) will not adequately support the proposed component systems of the MTACCS operational concept.

The focus of our research was to determine the ability of current Marine Corps tactical communications to support the MTACCS concept. To understand what MTACCS is today, we first had to examine the evolutionary process that MTACCS has undergone since its inception. We then looked at the capabilities of current tactical communications equipment to support data communications. We also examined the acquisition and development process to determine if communication equipment and MTACCS were being developed concurrently to create a fully integrated and seamless system architecture.

MARINE TACTICAL COMMAND AND CONTROL SYSTEM

The need for a MTACCS was first articulated in 1967 in Marine Corps General Operational Requirements. The Marine Corps issued the first MTACCS Master Plan in 1976 to provide policy and guidance for the integrated management of efforts to improve tactical command and control. The last update of that plan, in 1981, was incorporated into the Marine Corps Command and Control Master Plan (C2MP) in 1983. The MTACCS program went into a two-year period of dormancy

in 1987 when the cornerstone of the MTACCS concept, the Marine Integrated Fire and Air Support System (MIFASS), was terminated.

The objective of MIFASS was to automate the surface fire support functions of the MAGTF commander. The original 3-year program was funded for $7 million. Seven years and $236 million later, the MIFASS program was cancelled by former Commandant, General P.X. Kelly. (9:30) The reasons for the cancellation of the MIFASS program can be attributed to many factors. The ultimate problem was not with MIFASS itself, but with the concurrent development and fielding of critical communication systems to support it. (9:40) However, the MTACCS concept survived. The program has been revitalized and updated to reflect current needs and current technology. (4:41-42)

As articulated by former U.S. Marine Corps Commandant, General A. M. Gray, "MTACCS is an integrated, and automated C2 system with supporting tactical communications that covers all battlefield functional areas." (7:74) MTACCS uses the umbrella concept to pull together all the elements required to support the Marine Air Ground Task Force (MAGTF). MTACCS includes the component Command, Control, Communications, Computers, and Intelligence (C4I) systems which support the four functional areas of Ground C2, Aviation C2, Combat service support and intelligence, and the command support system application named Tactical Combat Operations (TCO). MTACCS is designed to combine information

from individual and disparate systems into an integrated system in support of the MAGTF commander and his staff.

If we look at the MTACCS game table, Figure 1, we see the separate functional area systems overlaid on the TCO system. TCO is designed to tie all the software packages together and allow for the sharing of information between the systems. If we look further, we see that the table is supported by MAGTF tactical communications. Communications within the MTACCS concept are envisioned to be transparent to the user. What happens if one of these legs breaks or is unable to support the weight of the table? We only need to go back a few years and examine the causes for the cancellation of the cornerstone system of the original MTACCS concept -- MIFASS.

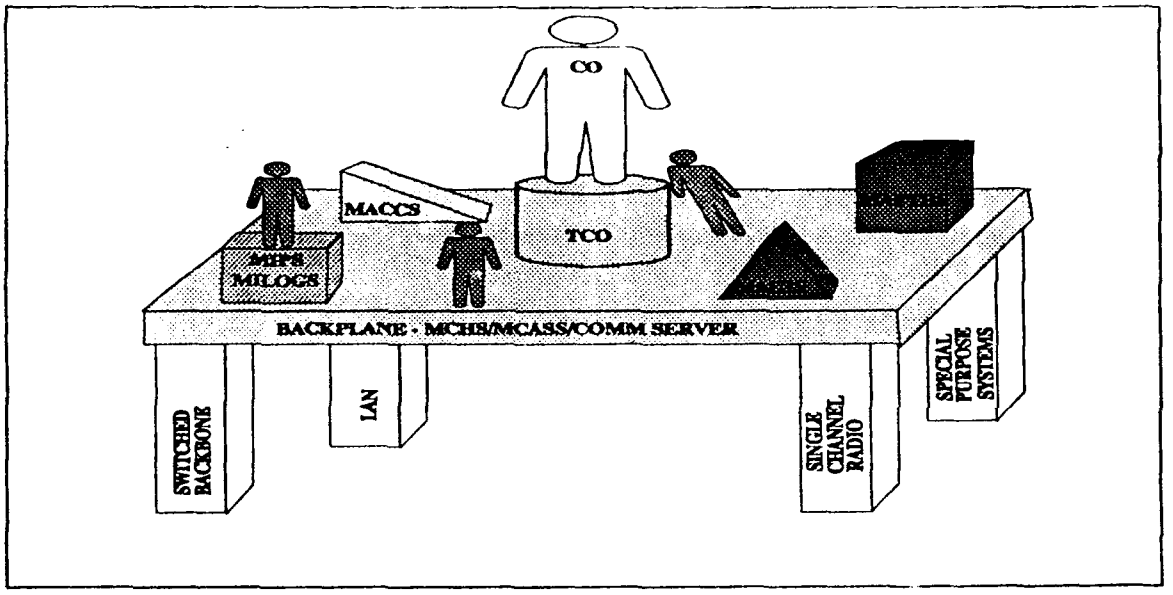

Figure 1. MTACCS Component Relationships

As stated in the MTACCS Operational Concept Document, the development of MTACCS is inextricably linked to the concurrent evolution of the MAGTF

communication system. Successful implementation of MTACCS depends on development and fielding of communication equipment that is capable of passing a large number of digital, burst-transmission messages across fewer communication links. The tactical communications architecture of the Marine Corps must evolve from a network of functionally dedicated voice channels into a system of information pipelines connecting various elements of the MAGTF.

As planned now, MTACCS will be an evolutionary acquisition, slowly procured and tested piece by piece, with the new hardware suites and software beginning to replace the old systems during the late 1990's. Currently, MTACCS is developing software and hardware black boxes to integrate existing systems. This integration was recently tested at Twentynine Palms, California, during the Field Development System (FDS-1) test in November 1991.

The primary focus of the test was to see what software problems exist in interfacing so many different systems. Several problems were encountered during the test, but one problem which had been overlooked was the communication system requirements. To date, no specific data rate requirements or circuit quality standards have been developed for any of the MTACCS component systems. The philosophy is that they will use what communications assets are in the inventory until standards can be developed through future testing. (8:7) This means that information pipelines to support MTACCS component systems will be required to be carried on the already-saturated voice radio nets.

Tactical Communications Architecture

The keystone of any command and control system is the communications backbone. Without the ability to receive and pass information among his forces in a timely manner, the battlefield commander will lose the speed necessary to influence the outcome of the battle. The communications system must be capable of passing voice, data, facsimile, and video or imagery. To do this, the Marine Corps employs a variety of tactical communications systems that include single channel radio and switched backbone, which incorporates multichannel radios and tactical switchboards.

Single Channel Radios

Single channel radios provide the primary communications link between the command element and its major subordinate commands during amphibious and mobile offensive operations. (See Table I.) The current family of VRC-12 (VHF) and UHF radios are capable of passing secure analog voice and data at rates up to 16 kilobits per second (Kbps) over a circuit under optimal conditions utilizing a modem and a TSEC/KY-57. However, the VRC-12 series' capability to provide a quality circuit is limited because of the radio's tendency to slip out of frequency alignment due to the age of the equipment.

Table 1.
Single Channel Radio Equipment

SPECTRUM	EQUIPMENT	STATUS
VHF	AN/VRC-12 SERIES	FIELDED
	SINCGARS	PLANNED 1994
UHF (LOS)	AN/PRC-113	FIELDED
	AN/VRC-83	FIELDED
UHF (SATCOM)	AN/MRC-140	FIELDED
	AN/PSC-3	FIELDED
	AN/TSC-96	FIELDED
HF	AN/PRC-104	FIELDED
	AN/MRC-138	FIELDED
	AN/GRC-193	FIELDED
	AN/TSC-95	FIELDED
	AN/TSC-120	PLANNED 1993

VHF/SINCGARS Radios

Even though the new Single-Channel Ground Air Radio Systems (SINCGARS) have been purchased to replace to the VRC-12 series, the bandwidth capacity will still be limited to 16 Kbps in the VHF portion of the frequency spectrum. However, SINCGARS' greater power output will reduce the signal to noise ratio (SNR) and will provide a higher quality circuit than the VRC-12 series. Although the Marine Corps' SCR circuit quality will be improved by the planned fielding of SINCGARS, the throughput limitations of the VHF radios will remain unchanged.

UHF/UHF-SATCOM Radios

Both VHF and UHF radios are limited to line of-sight (LOS) transmissions. UHF-SATCOM terminals alleviate the LOS limitation; however, congested satellite channels, network saturation, and asset availability are limiting factors when employing UHF-SATCOM radios.

HF Radios

HF radios provide responsive, transportable, low cost, long-range communications available at most echelons, yet a reliable HF circuit depends on many variables. The HF spectrum is congested, and atmospheric distortion and propagation anomalies are difficult to predict and not fully understood by the layman. The most significant limiting factor of the HF medium is the narrow bandwidth, which equates to a very slow maximum data rate of 2.4 Kbps.

Switched Backbone

The Switched Backbone network supports the telephonic and data circuits necessary for extensive command and control once the MAGTF is established ashore. The Switched Backbone architecture is currently in transition to a completely digital secure voice system comprised of circuit switches, terrestrial and SATCOM multichannel radios, fiber optic cable system, and telephones with data channel interface features. (See Table II.) The switched backbone will provide efficient, high capacity communications at the expense of mobility. The success of

MTACCS, or any high data rate communication system, depends primarily on the Switched Backbone network.

Table II.
Switched Backbone Equipment

SPECTRUM	EQUIPMENT	STATUS
VHF	AN/MRC-135	FIELDED
	AN/MRC-135 (MOD)	PLANNED
UHF (LOS)	AN/GRC-201	FIELDED
	AN/MRC-142	PLANNED 1995
SHF (LOS/TROPO)	AN/TRC-170	PLANNED 1995
SHF (SATCOM)	AN/TSC-93	FIELDED
	AN/TSC-85	FIELDED
SWITCHBOARDS	AN/TTC-42	FIELDED
	SB-3865	FIELDED
	SB-3614	FIELDED
	SB-22	FIELDED

When the command element phases ashore during amphibious operations, a switched backbone network will be necessary to support the tremendous volume of information flowing between the command element and the major subordinate commands. (3) The recent fielding of the digital switchboards, TTC-42 and the SB-3865, combined with the GMF suites currently fielded, is a giant step towards the end-to-end digital system. The only shortfall that remains is the terrestrial digital multichannel radio systems which are planned to be fielded in the mid to late 1990's. Once the terrestrial systems are fielded, an end-to-end digital secure voice and data system will be complete down to the regimental level.

MARINE CORPS ACQUISITION AND DEVELOPMENT PROCESS

For the MTACCS concept to become a reality, the Marine Corps Tactical Communication Architecture must evolve simultaneously and in concert with component systems dependent upon communication networks to succeed. As previously noted, communication system development has not been done in concert with component systems and resulted in the demise of MIFASS. An examination of the Marine Corps acquisition and development process reveals the problems associated with the expeditious fielding of the component systems of MTACCS.

The acquisition process is initiated with the development of a Mission Needs Statement (MNS) and consists of five major milestone decision points and five phases, illustrated in Figure 2. This process provides a basis for the comprehensive management and the decision-making required for a successful acquisition program.

The Mission Needs Statement (MNS) documents a mission deficiency, in broad operational terms, or an opportunity to improve mission accomplishment. Validation of the MNS, at Milestone 0, gives the Program Manager (PM) the authority to expend resources to proceed with the Life Cycle Management (LCM) process by exploring and developing alternative solutions to the mission need.

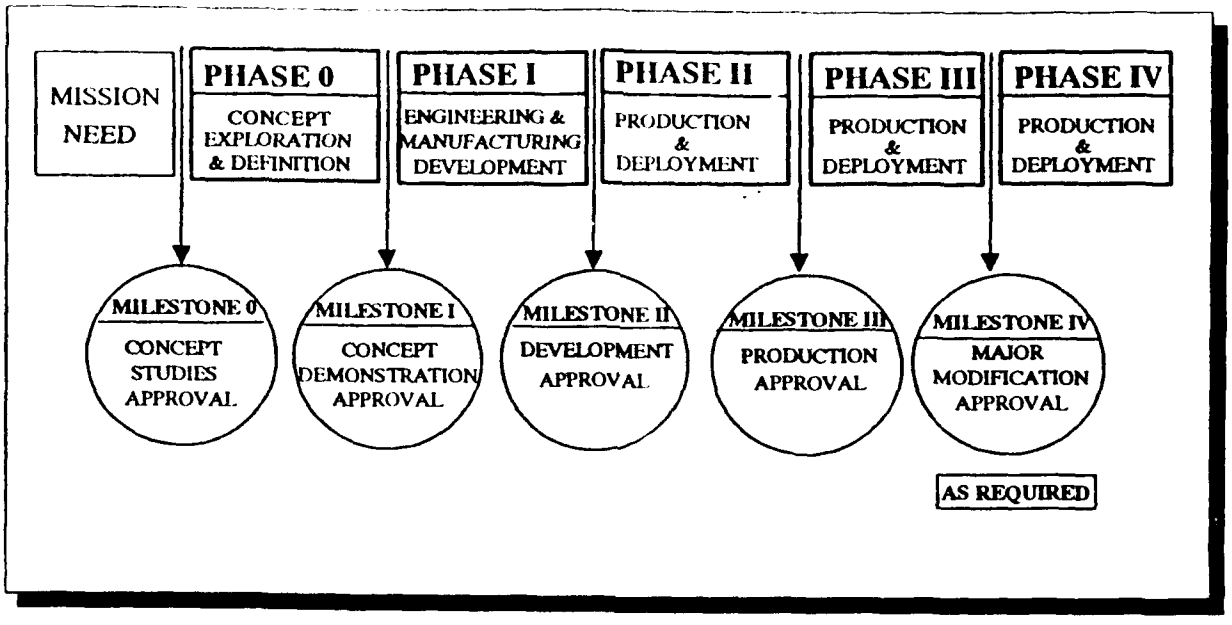

Figure 2 . Acquisition and Development Process

The objectives of Phase O are to define and evaluate the feasibility of concept(s) and provide a basis for assessing the relative merits of concept(s) at Milestone I decision point. During this phase significant assumptions and constraints on any solution are identified, and life cycle cost and operational analyses are prepared for each concept explored. Cost, schedule, and performance objectives, which constitute the program baseline, will be generated for the most promising concept(s).

The objectives of Phase I are the definition of critical design characteristics and expected capabilities of the system concept(s), demonstration of feasibility of critical technologies, proof that critical processes of the most promising design approach are understood and attainable, and establishment of a proposed development cost/schedule/performance baseline for the most promising design approach.

The objectives of Phase II are the translation of the most promising design approach developed in Phase I into a stable, producible, and cost effective system design; validation of the manufacturing or production process; and verification through testing that system capabilities satisfy mission need and meet minimum acceptable operational performance requirements.

The objectives of Phase III are the fielding of the system and the establishment of a support base; achievement of an operational capability that satisfies the mission need; and the conduct of follow-on operational testing to confirm and monitor performance, quality, and correction of deficiencies.

The objectives of Phase IV are that the fielded system continues to provide the capabilities required to meet the identified mission need and to identify shortcomings that must be corrected to improve performance.

Finally, the objectives of Phase V, as required, are to implement major system redesign or development. This process, although dictated by Department of Defense (DOD) and Department of Navy (DON) regulations, does not necessarily produce the desired product for the Fleet Marine Forces in a timely manner. In part, due to the failure of MIFASS, the Marine Corps Systems Command has instituted a Field Development Systems (FDS) test to enhance procurement efficiency and viability. Ultimately, the FDS test cycle has not solved the underlying problem. Communications systems have continued to be developed separately from the component systems of MTACCS. This problem was predicted

and verified during FDS-1 held in November 1991 at Twentynine Palms, California. (1:2)

ANALYSIS

While the concept of tying together multiple tactical systems is valid and a necessity for the future battlefield commander, the communications connectivity needed to support MTACCS is not currently available below the regiment/group level. Once the transition from analog to digital is completed, a bandwidth limitation will still exist during amphibious operations and during highly mobile offensive operations where SCR is the primary means of communication.

The proliferation of computer hardware and software throughout the Marine Corps during the 1980's has proven to be a tremendous technological leap forward. Local Area Networks (LAN) and Wide area networks (WAN) installed, operated, and maintained during Desert Shield and Desert Storm proved to be highly effective. In fact, during a 36-hour period at the start of operation Desert Storm, over 1.3 million messages were passed over I MEF's LAN/WAN system. (16:79) Although the automated information flow within the MEF proved adequate, communication systems were the limiting factor in fully exploiting this capability. It is important to note that Marine amphibious forces stationed off-shore were not able to effectively interface with the command element of the MEF. Another important point that must be considered concerning Desert Storm is the extreme reliance on SCR voice communications during the offensive phase of the operation.

As stated by LtGen Boomer, "Automation is fine, but commanders need to be close to the battle and able to talk to subordinates." (3) Once command posts unhooked from the extensive switched backbone communications network, automated information flow proved to be ineffective. (24)

During the first Field Development System (FDS-1) test of MTACCS, held at Twentynine Palms in November 1991, many system flaws were uncovered. MTACCS Program Manager Colonel Michael Stankowsky stated, "When you put as complicated a system as MTACCS in the field that integrates all these functional areas together, it is tough. Your biggest problem is communications." (14:37) Additionally, Major William Hessler, the MTACCS Deputy Program Manager, admitted that the MTACCS system could not be unhooked from hardwire cable and be transmitted over current tactical radio systems during FDS-1. (14:37)

RECOMMENDATIONS

As previously stated, the concept of automating command and control systems is valid and needed. Commanders throughout the Marine Corps continue to stress this fact and are pressing the issue of making the technology explosion meet their warfighting needs. To make MTACCS viable, some fundamental issues need to be addressed.

1. Commanders must identify their critical information requirements. A simplistic statement of "I need everything" just confuses the issue. Staffs and

subordinate commanders assume a quantity over quality approach to appease their commander. This paralyzes the communications network with an unlimited flow of data. The generation of information for its own sake has no operational bearing; information must be relevant to a situation and not just be an endless stream of data providing marginal update. Operational commanders must define the specific requirement that MTACCS must fulfill. Those responsible for the research and development of MTACCS at the Marine Corps System Command and the corporate technicians cannot adequately determine system requirements. The broad and ambiguous guidance derived from the Mission Needs Statement has resulted in a bureaucratic dream. In reality, few concrete objectives have to be met for the funding of MTACCS to continue. Instead of fielding systems, the emphasis has focused on validating a concept.

2. The most critical obstacle to the successful implementation of MTACCS is the current research, development, and acquisition process. Communications systems must be developed and fielded in conjunction with the MTACCS component systems. Developing the component systems of MTACCS and disregarding the communications network required to support them tempts history to repeat itself--MIFASS revisited. In an attempt to preclude this costly mistake, the FDS tests were devised. Unfortunately, the results were the same. Once again, the process of ultimately fielding a system while ignoring communications integration has produced unacceptable results.

3. In addition to commanders defining their requirements and the obvious modification of the acquisition and development cycle, staff functions need to identify their communications requirements. The flow of intelligence information, for example, requires massive communications pipelines to support imagery and video transmissions (6 MHz bandwidth). By defining bandwidth requirements, systems technicians and controllers can plan for the flow and control of information within the MEF. This also may limit the extent of intelligence dissemination.

4. Finally, the MTACCS Program Managers need to define realistic tactical communication support requirements. The ability of tactical command posts to use automated information systems technology is constrained by environmental conditions, mobility, and maintenance support. To date, these problems have been ignored.

CONCLUSION

The management, proper exploitation, and dissemination of information is a force multiplier, but communications is the glue that holds the rest together. The MTACCS concept has been validated continuously since the Vietnam War. The requirement exists. We no longer need to waste time validating this requirement. The time has come to make the concept a reality and put something on the table. To do so, the communications architecture must be developed in concert with the component systems of MTACCS.

SUMMARY OF ACRONYMS

C2	Command and Control system
C3I	Command, Control, Communications, and Intelligence
C4I	Command, Control, Communications, Computers, and Intelligence
DOD	Department of Defense
DON	Department of the Navy
FDS	Field Development System
Kbps	Kilobits per second
GMF	Ground Mobile Forces
HF	High Frequency
LAN	Local Area Network
LCM	Life Cycle Management
LOS	Line of Sight
MAGTF	Marine Air Ground Task Force
MCTCA	Marine Corps Tactical Communication Architecture
MEF	Marine Expeditionary Force

MIFASS	Marine Integrated Fire an Air Support System
MNS	Mission Needs Statement
MTACCS	Marine Tactical Command and Control System
MUX	Multichannel
PM	Program Manager
R&D	Research and Development
SATCOM	Satellite Communications
SCR	Single Channel Radio
SHF	Super High Frequency
SINCGARS	Single-Channel Ground Air Radio Systems
UHF	Ultra High Frequency
VHF	Very High Frequency
WAN	Wide Area Network

BIBLIOGRAPHY

1. Boeke, G. A., Major, USMC. "MAGTF Integration Team, MCCDC, Trip Report for MTACCS FDS-1 Evaluation: 17 - 24 November 1991." 4 Dec 1991.

2. Boeke, G. A., Major, USMC. Personal interview, MCCDC. 15 Jan 1992.

3. Boomer, W. E., Lieutenant General, USMC. Personal interview, MCCDC. 21 Jan 1992.

4. Boros, Louis L., Lieutenant Colonel, USMC. "Automated Command and Control for the MAGTF: Can It Be Done?" Marine Corps Gazette, Dec 1990: 40-43.

5. Coates, Robert A., Major, USMC. "Automated Support for Command and Control." Marine Corps Gazette, Dec 1990: 36-39.

6. Cohen, R. S., Lieutenant Colonel, USMC, Personal interview, MCCDC. 15 Jan 1992.

7. Command System Incorporated. "MTACCS FDS 1: An Evolutionary Development Success." Amphibious Warfare Review, Vol 9, No. 1, Summer 1991: 74.

8. Commanding General, USMC, MCCDC. Marine Tactical Command and Control System (MTACCS) Operational Concept. 3 Apr 1990.

9. Geving, Donald L. Management of MIFASS, A Marine Corps C2 System, Naval Post Graduate School Thesis Paper, Sep 1987.

10. Gray, Alfred M., General, USMC. "Marines Streamline C3I, Merge Interoperability." Signal Magazine, Nov 1989: 81-83.

11. Hans-Henning von Sandrart, General, GA. "The Holy Grail of Command, Control and Communications." Signal Magazine, Oct 1988: 32-35.

12. Joint Chiefs of Staff Publication 1 (JCS Pub 1). U.S. Government Printing Office, 1 Jun 1987.

13. Moore, John R., Colonel, USMC. "Communications and Maneuver Warfare." Marine Corps Gazette, Mar 1990: 29-30.

14. Munro, Neil. "Marines Review Development of C2 System After Failed Test." Defense News, 9 Dec 1991: 37.

15. Mutter, C. A., Brigadier General, USMC. "Letter to the Editor." Defense News, 6 Jan 1992: 22.

16. Pierce, Jr., Merril L., Major, USMC. "Established Architecture Keys Marine Desert Data." Signal Magazine, Aug 1991: 77-79.

17. Ricci, Fred J., and Daniel Schutzer. U.S. Military Communications: A C3I Force Multiplier. Computer Science Press, 1986.

18. United States Marine Corps. Warfighting, FMFM1. 6 Mar 1989.

19. United States Marine Corps. Command and Control Systems, OH 3. 18 Jun 1986.

20. United States Marine Corps. Tri-MEF Standing Operating Procedures for Communications and Computer Systems, FMFRP 3-32. 8 Nov 1989.

21. United States Marine Corps. Brief Descriptions of U.S. Marine Corps Communication-Electronics Equipment, TM-2000-15/1. 30 Jun 1983.

22. United States Marine Corps. MTACCS Master Acquistion Plan. 26 Dec 1990.

23. Van Creveld, Martin L. Command in War. Cambridge, Massachusetts: Harvard University Press, 1985.

24. Vohaska, M.L., Major, USMC, Telephone interview, Communications Company, 1st Marine Division. 13 Feb 1992.